# The Canadian Entomologist

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## RETIREMENT OF DR. E. M. WALKER AS EDITOR.

Owing largely to increased duties, Dr. Walker has found it necessary to tender his resignation as Editor of the Canadian Entomologist. When his esteemed predecessor, the Rev. C. J. S. Bethune, found it necessary to relinquish the editorial duties, the Council of the Entomological Society of Ontario was fortunate in persuading Dr. Walker to take up this work. Dr. Walker has served the Society and entomologists generally for a period of eleven years in a most faithful and painstaking manner, and as President of the Society I feel that I am voicing the opinion of all our members and subscribers in recording here our warm appreciation of his valued services during such a long period. Dr. Walker has enriched to a marked degree the literature relating to Canadian insects, and in view of his personality and his attainments he is held in high regard, not only by entomologists resident in Canada, but by those of other countries as well.

The duties of an editor are not always along paths strewn with roses, and for this and other reasons one sometimes wonders why any person is persuaded to edit a scientific journal. The true reason, of course, is a love for the work for its own value and the effort to assist in the general advancement of the science. Dr. Walker has certainly conducted his duties in a most pleasing and acceptable manner. We wish him further success in the important work he is doing at the University of Toronto.

As mentioned in the January number, Dr. J. H. McDunnough, Chief of the Division of Systematic Entomology, Entomological Branch, Department of Agriculture, Ottawa, Ont., has been appointed Editor in place of Dr. Walker. Dr. McDunnough has a wide reputation as an entomologist, and the Society is fortunate in securing his services.

ARTHUR GIBSON.

## POPULAR AND PRACTICAL ENTOMOLOGY.

### THE LIFE-HISTORY OF A HOBBY HORSE.

BY FRANCIS J. A. MORRIS,
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### PART. II.—BOY AND MAN—SAPLING GROWTH.

(Continued from page 5, Vol. LIII.)

Slyboots and I had already suffered a partial separation; he attended a school at Gypsey Hill, while I was entered at Dulwich College. Among his teachers was Theodore Wood who gave lessons in Entomology, and it was at this time that we acquired his kinsman's books on British Moths and on Beetles, and thus laid the foundations of a little library including Coleman's Butterflies, Atkinson's Birds' Eggs and Nests, and a work illustrating Spiders, Dragonflies, Wasps and other Insects, which has long vanished, even to its author's name.

Among my brother's schoolmates was one whose life ambition was to be a doctor, and already at 15 he took his profession and things in general very seriously. In the newcomer's friendship I had of course some share—a jackal's if not a lion's—and was allowed to attend the séances held in a room over his father's coach-house. These séances were mostly of a chemical character, accompanied by mephitic odours and ending in loud, glass-flying explosions. Various creatures, birds and mammals, were boiled down and their bony anatomy taken apart and then carefully reconstructed. His greatest treasure was a human skeleton, begged, borrowed, and bought piecemeal and with great trouble; it was far from perfect and some of the parts had been contributed (without their consent) by lower animals; it was not even entirely of one sex, and its age varied from a small boy's to an old woman's. This monstrous apparition occupied a kind of dias at one end of the attic and never failed to lend an atmosphere of awe to this young Sawbones' feasts of reason.

It was under his guidance that we made our way to quite distant points in the country side, Streatham Common, Epsom, stretches of the river Mole by Box Hill and Leatherhead, and Carshalton with its beautiful reaches of the river Wandle, subject of one of Ruskin's most eloquent laments. His favorite out-door hobby was fossil-hunting, and it was by that avenue that we were led to our first view of the chalk downs near Caterham Junction. We took train to Croydon and then tramcar a mile or two beyond. Here lay some chalk pits in the side of a broad expanse of rolling heath. Many a long hour in the dazzling glare of the chalk did we spend, digging out sea-urchins, trilobites, ammonites, anemones, sponges, corals, and shark's teeth from the walls of the pit, or raking over refuse heaps. And, of course, it was not long before we discovered how interesting were the downs that had covered this prehistoric chalk bed with new and varied life. There were numbers of stone-chats, and plovers, and larks about the thickets of gorse; once a hare being coursed, with backward-staring eyes, sprang full against my legs as it mounted the hillside. On the downs we captured several "hair-streaks" and "chalk-blues" that were entirely new to our collection, and on the homeward trip one day we had an encounter that capped them all for thrills.

We had made our way down from the breezy heath into a hollow road with high, uncut hedges on either side, and presently the road widened out into two, an upper gravel road and a low wagon track, with a gentle slope of short grass between. Up and down about this turfy space went flights of the most beautiful creatures we had ever seen; they flew low and somewhat heavily, an easy mark for the net. The forewings were deep indigo-green with large spots of rich crimson, the hindwings entirely crimson, both pairs long and narrow, gently rounded at the apex. It proved to be the 6-spot Burnet Moth, one of the *Zygænidæ*, a family not very well represented on our continent of North America.

The astonishing beauty of these Burnet Moths in the sunlit lane has helped to impress the whole scene of this first encounter indelibly on the mind. Even now as I bend my thought steadily on this remote point of the past, every detail of the road stands out again like some invisible ink under the action of sunlight.

The wild luxuriance of the uncut hedges, festooned with bryony and traveller's-joy, and gay with roses, the widening roadway with a grassy space in the middle, the flash of discovery, the eager chase, the triumph of capture, all comes back to me, even to the figure of the boy kneeling over his net in the turf, and presently, as the scene is thus unrolled before me, like something laid away in lavender and fresh from memory's store-room, from its inner folds a most wonderful fragrance comes wafted to me over 36 years till the whole air is redolent with it, and I know that wild thyme must have been blowing all about that grassy bank where these fairy birds of Paradise were flying.

A rarer treat than all these trips of our own planning was a visit to our cousins in Chislehurst. This always meant a day teeming with excitement and netting us many a rare addition to our cabinet. The very moment we entered my uncle's big kitchen garden on our initial visit, we spied the first real live Peacock butterfly we had ever seen, sailing down towards a patch of "live-for-ever"; this bed of orpine proved a regular paradise of a hunting ground, where we captured Brimstone butterflies, Red Admirals, Tortoiseshells, and Peacocks in dazzling succession. Upon the enclosing walls of the kitchen garden were trained the spreading branches of various fruit trees, pear, cherry, peach, apricot and nectarine; and all about among the clustered blossoms and fruit hung bottles and other contrivances for catching insects; these were all carefully examined and several new specimens of beetle or wasp or moth or butterfly fished out; most of these traps were filled with liquid, and the lepidopters were spoiled, but here and there hung a kind of glass cage in which live prisoners could be seen still fluttering.

After exhausting for the nonce all the treasures of this Eldorado we passed out of a postern gate in the wall to a gymnasium on the edge of a small wood. Here while rummaging about I discovered a great rarity—the only genuine English hornet I have ever clapped eyes on; it was lying in a clutter of cobwebs at the corner of one of the tall windows, stark dead, but a perfect specimen for the cabinet.

This first visit to Foxbury was, I really believe, unparalleled for the range and splendour of its captures. And before we returned home each of us had another windfall of luck to his share; Slyboots went hunting along a privet hedge not far from the kitchen garden, and presently excited shouts of some wonderful prize brought me tearing across one of my uncle's pet flower beds from the heart of the shrubbery. An enormous caterpillar, striped and horned, of vivid green, was the cause of the outcry, and after gloating over it in envious admiration, I set to work feverishly searching an adjoining hedge. And fortune certainly proved lavish to both of us that day, for each took two more specimens busy feeding on the privet; they were all much of a size, though hardly of the same brood, unless the mother moth had laid its batch of eggs at widely different points.

In about four days they stopped feeding and pupated, but I cannot recall more than one emerging from the chrysalis as a mature Privet Hawk moth. Almost more wonderful than the plumage and spread of pinion of these miniature hawks was to watch the great larvæ feed and crawl. The skin was translucent

and you could see the movements of breathing and circulation quite plainly under the surface. During the active feeding the creature, I recall, when handled, gave a decidedly pleasant sense of contact, being plump, firm, and of remarkable coolness; when full fed, the skin hardened and became opaque.

It was on this visit, too, that we found the nests of the Lesser Whitethroat and the Spotted Flycatcher, the latter cunningly hidden under the thatched eaves of a cow-byre; over our heads in the oak wood we spied the beautiful long-tailed tit, and at our feet among the hazels great patches of wild hyacinth—the English "bluebell," so different from the Scotch flower of that name—the harebell. And on the way home in the growing dusk, as we passed down a lane between hawthorns and a chestnut grove, I was attracted by a rustling in the bushes, and presently the giant body of a beetle issued from the top of the hedge and launched itself into airy flight; the capture of this magnificent creature, an antlered male of the European stag-beetle *Lucanus cervus*) was for me the top-rung in the whole ladder of climbing wonders this day had lifted up before us.

We did not often make a visit to Chislehurst, but whenever we went we added some treasure of discovery. One showery afternoon I remember, I found clinging to the long grass blades in a hay-meadow my first specimens of the Orange-tip butterfly, and the Marbled White, an insect unknown in Scotland; again, on a brilliant day of July, just after lunch, I spied among the oaks a Purple Emperor, and after more than an hour's anxious watching was able to seize a lucky instant of its powerful flight and sweep it into the net from near the base of its imperial throne. These oak woods were a favorite haunt of the Night-jar or Goat-sucker, and on warm summer nights I often lay awake listening to the prolonged churring music of the bird; a sound that haunts the memory as lingeringly as the note of the Perthshire corncrake or the weird challenge of our Whip-poor-Will, its next of kin on this continent. Like the Night Hawk and the Whip-poor-Will, the bird rests lengthwise on the limb of a tree, and so perched, spins out its long-drawn purring monotone; the slightly ventriloquial character of the sound, they say, is due to the bird turning its head this way and that while singing. The structural affinity of these three birds and their kinship with the Swifts lent a double interest to my first meeting with the two American cousins of our British Night-Jar.

Before we had been three years in England, Slyboots set sail for Australia, and Merry Andrew was thrown once more on his own resources. School studies had already begun to claim most of my spare time, and the collection made little progress; once I captured a magnificent Muskbeetle, the only Longicorn with which I was familiar as a boy; once a visit to the South coast brought me into contact with the Clouded Yellow butterfly, whose powerful flight and wariness taxed all one's skill with the net; and a stay near Oxford secured me three or four new species of dragon-fly. But the boyish interest in collecting waned fast, and when our whole cabinet was stolen from a warehouse at Malvern during my freshman year at Oxford, regret at the loss of all these treasures so laboriously gathered and so lovingly guarded was deplorably quick in the passing.

(To be continued.)

# THE NERVOUS SYSTEM OF THE LARVA OF *STHENOPIS THULE* STRECKER.

BY J. M. SWAINE,
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(Continued from p. 283, Vol. LII.)

COMPARATIVE STUDIES OF THE LARVAL NERVOUS SYSTEM IN LEPIDOPTERA.

## A Summary.

A comparison of the nervous system of the larvæ of the Jugatæ with that of other caterpillars of the Lepidoptera and Trichoptera reveals several interesting conditions, two of which appear to have special significance.

It is not proposed to generalize too freely from the results of these few dissections, but rather to suggest that the well defined differences in the larval nervous system may be worth more exhaustive treatment in connection with the study of the phylogeny of the group. It may be that the larval nervous system in the Lepidoptera and Trichoptera has been less modified throughout the evolution of the groups than has any other organ of either larva or adult, and since the characters exhibited are so distinct that in some cases genera and even species may be determined from them, the evidence they present must be of value. Dissections of determined larvæ throughout the Trichoptera and in the lepidopterous families Nepticulidæ and Prodoxidæ, examples of which were not available to me at the time, should prove of special interest.

The Lepidoptera were divided by Professor Comstock into two sub-orders, the Frenatæ and the Jugatæ, the latter comprising the two families Hepialidæ and Micropterygidæ. Judged by the characters of the adult the members of the Jugatæ were considered to be the most primitive of the Lepidoptera; and the study of the pupal wing-venation of *Sthenopis thule* by Dr. MacGillivray supports this view. The most recent catalogues of the North American Lepidoptera do not recognize this subdivision into Frenatæ and Jugatæ but place the families Hepialidæ and Micropterygidæ as the lowest of the order. Still more recently the Micropterygidæ have been included with the Trichoptera.

It is, therefore, of considerable interest to find that the larval nervous system of *Sthenopis* and of one species of the Micropterygidæ are closely similar in the two most prominent characters and are far more widely separated from all the Frenatæ, as represented in our dissections, than are any two families of these so-called higher Lepidoptera from each other; that in one respect at least they are much more highly modified; and, further, that the larval nervous system of the Trichoptera agrees most closely in these characters with the higher families of the Frenatæ.

The larval stages of the primitive stock from which both Lepidoptera and Trichoptera have descended must surely have had a nervous system of a primitive type, and from this the nervous systems of our modern caterpillars and caddice-fly larvæ must have been derived.

Since the nervous system of primitive insects apparently included a double chain of ganglia, longitudinal connectives and transverse commissures throughout the length of the thorax and abdomen, with at least one pair of ganglia in each abdominal segment, evidence of advanced modification should be indicated

by cephalization of the abdominal ganglia and by adhesion and fusion of the longitudinal connectives. We should, therefore, expect to find the Jugatæ exhibiting a tendency towards retaining a larger number of abdominal ganglia and showing a lesser degree of fusion of the connectives, with the opposite tendencies becoming more strongly marked in the higher families of the Frenatæ. In the Rhopalocera at least we should expect to find a decided advance over the condition found in the Jugatæ. The actual condition is that the Jugatæ have one more abdominal ganglion, and are in that respect more primitive; but, on the other hand, they are infinitely more highly modified in that both the thoracic and abdominal connectives are completely fused for their entire length.

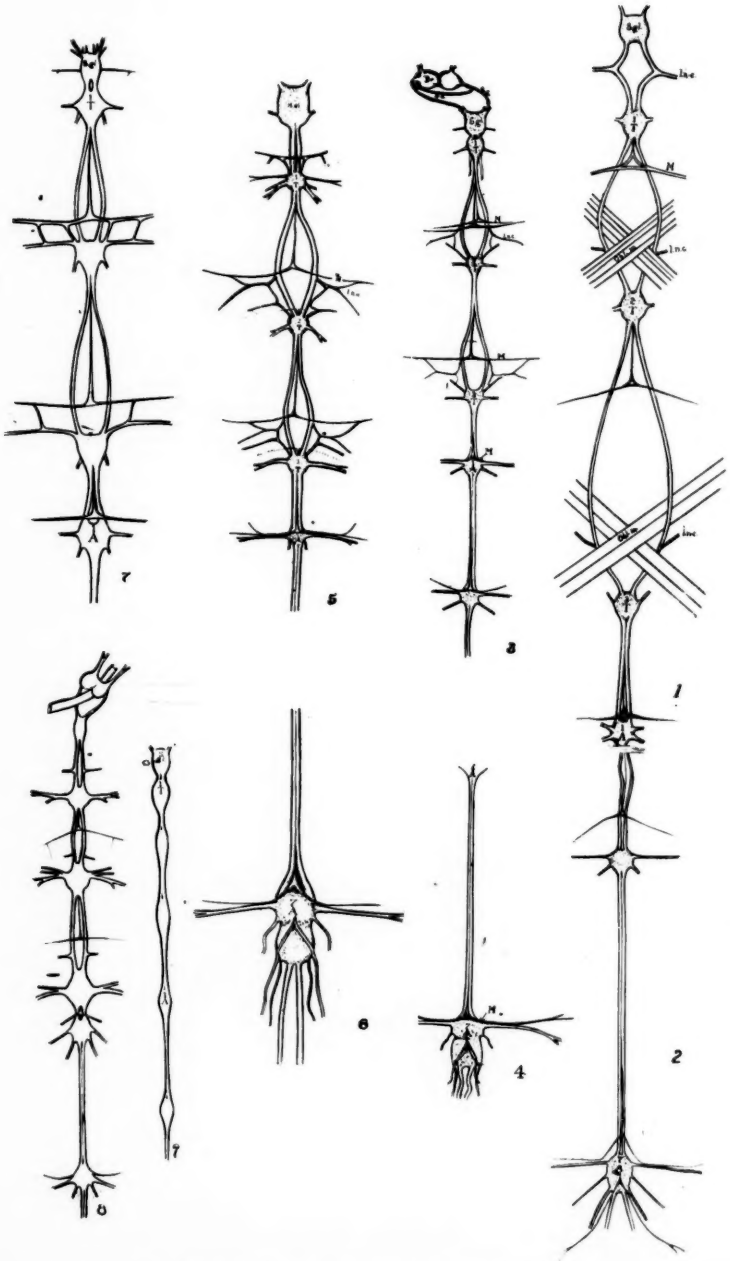
It is usually assumed that the Lepidoptera and Trichoptera are closely related in origin, and that the latter approximate more nearly to the original ancestral type from which both orders have apparently arisen. We should, therefore, expect the larval nervous system of the caddice flies to be more nearly like that of the lowest families of the Lepidoptera. It is interesting to find that the exact opposite is the case; the Caddice flies, as represented by the species dissected, approximate most closely in this regard to the Rhopalocera, and the Hepialidæ and Micropterygidæ stand out together remarkably distinct from both the Frenatæ and the Trichoptera.

In all the Frenatæ the connectives in the last two thoracic segments are widely separated, with the oblique muscles passing out between them. This, supposedly a primitive character, is especially prominent in the Rhopalocera, but occurs throughout the subfamily. Even in the abdomen the double origin of the connectives is indicated by an impressed median line, apparently throughout the Rhopalocera, in the Sphingidæ, and variably in other families of the Frenatæ. In the Jugatæ, however, as represented by the two species of *Sthenopis* and the eriocranid I have studied, these connectives are absolutely fused throughout the thorax as well as in the abdomen. When it is considered that this modification also involves a great alteration in the relations between the connectives and the oblique muscles of the thorax, it would appear that these larvæ of the Jugatæ are in this important character very much more highly modified than any of the Frenatæ.

On the other hand, the larvæ of all the Frenatæ appear to be more highly modified than those of the Jugatæ in that they have only seven abdominal ganglia in the ventral chain, although the last, the seventh, is always evidently composite, and in some groups partly divided into two ganglia. In *Sthenopis*, and also in the eriocranid dissected, there are eight abdominal ganglia, the last evidently composite.

The Trichopterous larvæ dissected have only seven abdominal ganglia and have the connectives in the thorax widely separated throughout their length, much as in the Rhopalocera.

The highly modified condition of the thoracic connectives indicates that the Jugatæ were separated from the main stock, from which the Lepidoptera and Trichoptera were derived, at a very early period, even before the separation of the Trichoptera and, following a different line of development, have retained markedly primitive characters in the wing-venation of the adult and the eight distinct abdominal ganglia in the ventral chain of the larva, although



NERVOUS SYSTEM OF LEPIDOPTERA.

(See page 34.)

passing far beyond all others of their kin in the degree of fusion of the connectives in the larval nervous chain.

## Further Details of a Few Dissections.

The nervous system was examined in a series of caterpillars representing all the families available at the time. A brief outline of a few examinations will be sufficient for the present purpose.

*Papilio polyxenes* Fabr.

Plate II, Figs. 1 and 2.

The condition shown in the figures appeared to be general in the butterflies. The thoracic connectives are widely separated throughout with the oblique muscles passing between them in the 2nd and 3rd thoracic segments, with a lateral nerve from the connectives of all three thoracic segments. The abdominal connectives are separated for a considerable distance in front of each ganglion and their double origin is indicated on the remaining part by a strongly impressed median line. There are seven abdominal ganglia, with the last longer than wide, but not constricted, indicating its double origin only by the number of nerves to which it gives rise.

*Ceratomia amyntor* Hbn.

Plate II, Figs. 5 and 6.

The infraœsophageal ganglion is thick and shows traces of an impressed median line. The connectives between that and the 1st thoracic ganglion are longer than in *Sthenopis thule* and distinctly separated, though adjacent. Between the 1st and 2nd thoracic ganglia the connectives are widely separated, except for a short distance behind the first ganglion, where they are adjacent. They are distinctly separated at their insertion into the 2nd ganglion. The connectives between the 2nd and 3rd thoracic ganglia are as those between the 1st and 2nd. Those between the succeeding ganglia are adjacent, but distinctly separated. This is a condition far removed from that in *S. thule* with an almost solid ventral cord.

Distinct nerves from the connectives are found between the 1st and 2nd and the 2nd and 3rd thoracic ganglia, but not elsewhere. They are connected with the transverse branches of the median nerves and with the first pair of nerves from the ganglia. The development of the median system is indicated sufficiently for the present purpose in the figure; as usual, it is most highly developed in the thorax. The last ganglion, the 7th abdominal, is elongate and evidently constricted.

*Sphinx kalmiæ* S. and A.

The ventral cord is similar to that figured for *Ceratomia*, except that the connectives are adjacent in the thoracic segments for almost the cephalic half of their length, and the abdominal connectives are much more completely fused, though still showing a median line. The median and connective nerves of the 3rd thoracic segment are complex, as in *Ceratomia*. The last ganglion is evidently complex, with a distinct constriction.

*Sphinx drupiferarum* S. and A.

The connectives are more slender in the abdomen than in *Ceratomia*, but still showing everywhere the median line which indicates their double origin. Those of the 1st abdominal segment are about three times the length of the

1st abdominal ganglion, and with the median line very heavily impressed. Those of the 7th abdominal segment are distinctly separated on both the cephalic and caudal thirds of their length. The last ganglionic mass, in the 7th segment, is in the form of two distinct ganglia, the last, or 8th, being separated from the 7th by extremely short but evident connectives.

*Tropæa luna* L.

Plate II, Figs. 3 and 4.

The connectives of the 1st thoracic segment are extremely short; the abdominal connectives are impressed along the middle line, and the thoracic connectives are fused for a short distance behind the 1st and 2nd thoracic ganglia.

*Eacles imperialis* Drury.

The connectives are widely separated between the subœsophageal and the first thoracic ganglia, widely separated on the caudal half only and adjacent in front in the 2nd and 3rd thoracic segments. In the abdomen the connectives are slender and completely fused except for a narrow but complete separation for a short distance in front of the ganglia. The median line can rarely be traced throughout the length in the abdominal connectives. This condition is in sharp contrast to that found in the Sphingidæ. The last ganglion is very elongate but only feebly constricted at the middle. The median nerve in the 2nd and 3rd thoracic segments is extremely complex.

*Schizura concinna* S. and A.

In *Schizura* the connectives between the subœsophageal and the 1st thoracic ganglion are short, hardly longer than the 1st thoracic, but separate and apparently without nerves; these latter appear to arise from the 1st ganglion. The connectives between the 1st and 2nd thoracic ganglia are united for the cephalic half and widely separated on the caudal half, with the usual nerve from each side and the oblique muscles emerging between the connectives. The median nerve of this segment is well developed and branches about one-third the distance in front of the 2nd thoracic. The connectives between the 2nd and 3rd thoracic ganglia are widely separated for the entire length, and the median nerves separate about one-third the distance behind the 2nd ganglion. The connectives of the abdominal segments are united, although the median line of union is visible and the two are distinct immediately cephalad of each ganglion. The last two ganglia are closely connected, without visible connectives, but recognizable as two ganglia.

*Datana ministra* Drury.

The connectives between the subœsophageal and the first thoracic ganglion are distinctly separated and slightly longer than the first ganglion. The next pair of connectives are separated, except for the cephalic eighth or less, and distinctly separated behind at their insertion; the connective nerves arise very close to the ganglion, less than one-half its diameter from it, and the median nerve branches about midway between the ganglia. The connectives in the 3rd thoracic segment are similar, but with the lateral nerves still closer to the ganglia and the median nerve considerably shorter. The connectives of the 1st abdominal segment are shorter, and divided for the caudal half of their length. The remaining abdominal connectives are fused completely, except for the median split in the caudal fifth. The last pair are shorter and divided for

nearly the caudal half. The last, 7th, ganglion is longer than wide, with a slight median transverse constriction, and evidently composite.

*Callopistria floridensis* Gn.

The connectives between the subœsophageal and the 1st thoracic are short and widely separated. Those between the thoracic ganglia are widely separated for the entire length. The median nerve branches about one-third the distance behind the ganglion. *The lateral nerves of the connectives are pushed backwards so that they arise from the base of the connective as it leaves the ganglion, and therefore appear almost to arise from the front angle of the ganglion itself.* The connectives between the third thoracic and the first abdominal are short and separated on the caudal third. The remaining abdominal connectives are slender, elongate, entirely fused on the cephalic four-fifths, and distinctly separated on the caudal fifth. The median nerves in the abdomen are very slender, degenerate, separating shortly before the ganglion, passing caudad and laterad for a short distance with the first ganglionic nerve of its side. The last two ganglia are united to form an elongate mass, and this is separated from the preceding ganglion by separated connectives not quite so long as the caudal ganglionic mass.

*Euxoa ochrogaster* Gn.

The connectives between the subœsophageal and the 1st thoracic ganglia are short but separated. The connectives between the thoracic ganglia are entirely separated, and divided by the oblique muscles. The lateral nerves from the connectives are close to the ganglia, those from the first pair arising at the base of the connectives as they leave the second thoracic ganglion, and those from the second pair arising a very short distance in front of the third thoracic ganglion. The median system is highly developed in the thorax. The connectives between the third thoracic and the first abdominal ganglion are less than twice as long as the ganglia and separated for almost the entire length. The remaining abdominal connectives, except the last pair, are fused except for a short distance, about one-sixth the length, immediately cephalad of the ganglia. The last pair of connectives are hardly longer than the last ganglionic mass and are separated for more than the caudal half of their length. The last ganglion is longer than wide and evidently represents the 7th, 8th (and 9th) very completely fused. A delicate pair of nerves arise from the caudal part of the dorsal face, representing the median nerves of the last segment.

*Geometridæ.*

A geometrid was dissected, an alcoholic specimen of uncertain species. The connectives in the abdomen are more closely united than in most others, and approach the condition found in *S. thule.*

The connectives between the subœsophageal ganglion and the 1st thoracic are short, hardly longer than the 1st ganglion but quite distinctly separated. The connectives between the three thoracic ganglia are separated for almost the entire length, lying side by side for less than a fifth the length behind each ganglion. The median nerves are well developed as are the lateral nerves of the connectives, which arise a short distance in front of the ganglia. The abdominal connectives are thoroughly fused on the cephalic four-fifths of their length, forming a simple cord, but are distinctly though slightly separated for

nearly a fifth of their length before each ganglion, with the well-developed median nerves arising between them well in front of the ganglion. The last two abdominal ganglia are adjoined with an indication of very short connectives.

*Prionoxystus robiniæ* Peck.

Plate II, Fig. 7.

The connectives in the thorax are adjacent for a short distance, and those in the abdomen are split for one-fourth their length in front of each ganglion. There are seven abdominal ganglia, the seventh solid but composite. The median system is very coarsely developed in the thorax.

*Micropterygidæ.*

Plate II, Fig. 9.

I have been able to obtain caterpillars of one species of this family through the kindness of Mrs. J. D. Tothill. The larva is a miner of *Spiræa discolor* on Vancouver Island. The material was collected by Mrs. Tothill and determined by her as probably belonging to the genus *Mnemonica*. The caterpillars had been a long time in alcohol, and the lateral nerves could not be isolated satisfactorily. The ganglia and connectives were distinct, however, and are represented roughly in figure 9. The thoracic ganglia are very large and the thoracic connectives are thick, rather short and completely fused throughout their length, except for a median impression in front of each ganglion. There were eight abdominal ganglia. So far as this evidence goes, therefore, the Micropterygidæ stand with the Hepialidæ, forming a group very widely separated from both the Frenatæ and the Trichoptera

*Trichoptera.*

Plate II, Fig. 8.

Only one species of this Order was available at the time; it was an undetermined species belonging to the Phryganeidæ.

The ventral chain agrees closely in its most striking characters with those of the Rhopalocera. The connectives of the thorax are definitely separated throughout their length, giving rise to distinct lateral nerves, and there are only seven abdominal ganglia. Further dissections throughout this order may show very interesting conditions.

PLATE II.

Figs. 1 and 2.—*Papilio polyxenes* Fabr. Part of the ventral chain.

Figs. 3 and 4.—*Tropæa luna* L. Ventral chain of the larva, brain and subœsophageal ganglion to the second abdominal ganglion and the last.

Figs. 5 and 6.—*Ceratomia amyntor* Hbn. Ventral chain of the larva, subœsophageal ganglion to the first abdominal ganglion and the last.

Fig. 7.—*Prionoxystus robiniæ* Peck. Ventral chain of the larva, subœsophageal ganglion to the first abdominal ganglion, showing origins and lateral nerves of the thoracic segments.

Fig. 8.—*Trichoptera.*—Ventral chain of an undetermined larva belonging to this order. Brain and ventral chain caudad to the second abdominal ganglion, showing origins of median and lateral nerves.

Fig. 9.—*Micropterygidæ.* Ventral chain of a larva of the genus *Mnemonica* showing only the ganglia and connectives of the ventral chain from the subœsophageal to the second abdominal ganglion.

# A NEW CLASSIFICATION OF THE ORDER PERLARIA.

BY R. J. TILLYARD, M. A.
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For some years past I have been studying the Perlaria of Australia and New Zealand, about which little has been made known up to the present. Taken in connection with the forms already described from Southern Chile, Patagonia, Tierra del Fuego and the Subantartic Islands, these insects form a very distinct Notogæan Fauna, clearly marked off from the Perlaria of the Northern Hemisphere and of the Tropics by the fact that it is made up almost entirely of very archaic types. No representatives of the highly specialized Perlidæ (including Perlodidæ) occur in these regions; no Pteronarcidæ, in the strict sense in which that family will be defined in this paper; no Capniidæ, Taeniopterygidæ or Leuctridæ; and only one or two isolated forms of Nemouridæ (genus *Udamocercia* of Enderlein).

In attempting to classify the known Notogæan forms of Perlaria, I have had recourse not only to all available imaginal characters, but also to as careful a study of the individual life-histories as the rareness of most of the forms would permit. I am now able to state that, as regards Australian and New Zealand forms, the classification adopted by me, on imaginal characters only, has been fully tested in the case of the corresponding larvæ, with the result that these latter are found to group themselves into distinct families as readily as do the imagines, so that the two sets of characters taken together form a most useful and easily understood classification.

The most archaic forms of Perlaria extant are to be found in the genus *Eusthenia* and its allies. These have no close relationship with the Pteronarcidæ as defined in this paper, the latter being specialized by the reduction of the mandibles, the approximation of the coxæ of the forelegs, by the loss of the primitive paired abdominal appendages on segments 1–6, (secondary gill-tufts on the thorax and base of abdomen are developed in some genera), as well as by loss of the original palaeodictyopterous mesh-work or *archedictyon* in the anal area of the hindwing, and by the presence of a distinct break in the contour of the outer margin of the hindwing, at the distal end of $Cu_2$, where the anal fan leaves the rest of the wing. Thus the only primitive characters left to the Pteronarcidæ in common with the Eustheniidæ proper are the form of the tarsal joints, the visible clypeus and labrum and the presence of numerous cross-veins in the distal portions of the forewing. In contrast with this, all the true Eustheniidæ have a primitive larval form possessing five or six pairs of lateral abdominal appendages functioning as gills, on the first five or six segments of the abdomen, but no secondary gill-tufts at all. These primitive paired gills are closely similar to those found in the larvæ of certain archaic Calopterygidæ in the Order Odonata. They are carried over into the imago at metamorphosis, as are the secondary gill-tufts of *Pteronarcys*, but quickly shrivel up. In the imaginal stage, true Eustheniidæ possess an altogether complete set of archaic characters, as follows: In the forewing, a complete archedictyon or cross-venation in all parts of the wing, a complete set of cross-veins between $Cu_2$ and 1A, a radial sector with three or more branches, a first

cubitus with two or more branches, in most genera showing a primitive anteriorly-arching type of branching, and at least three complete anal veins; in the hindwing, the outer margin with a single complete convex contour, without any re-entrant break or angle at the distal end of $Cu_2$ (this character is unique for

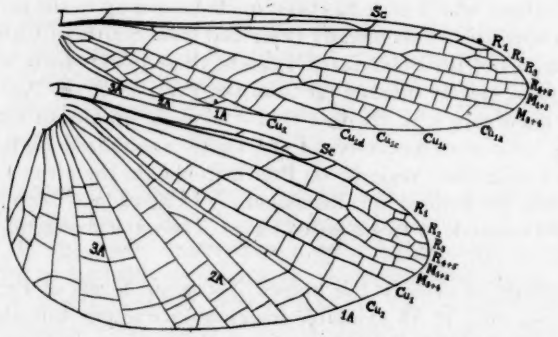


*Fig. 1.*—Venation of *Stenoperla prasina* (Newm.), family Eustheniidae, (New Zealand). The genus *Eusthenia* itself has broader wings and still denser venation.

the family), the radial sector branched, and the archedictyon completely preserved on the anal fan, as well as on the rest of the wing. (Text Fig. 1*). Other archaic characters are the form of the tarsal joints, the wide separation of the front coxæ, the presence of strong functional mandibles and a clearly visible clypeus and labrum.

Separated from these by clear characters, but still very archaic, are the genera *Austroperla* Needham and *Tasmanoperla* n. g. (type *Eusthenia diversipes*, n. sp.), which differ from the true Eustheniidæ in having shorter cerci, somewhat more reduced but still primitive venation, at least a partial fusion of $M_{3+4}$ with $Cu_{1a}$ in the hindwing, no archedictyon on the anal fan, and a distinct re-entrant angle on the outer margin at the distal end of $Cu_2$. (Text Fig. 3). In order to test the validity of this family, I sought carefully for larvæ of a different type from those of Eustheniidæ, and finally discovered in Tasmania a long cylindrical larva without any gills at all, and with rather short cerci, from which I reared a new species of *Tasmanoperla*, not yet described. Later on, I also obtained a closely similar type of larva from New Zealand, and reared from it *Austroperla cyrene* Newm. Thus the formation of this new family was fully justified.

Numerous species occur in which a considerable measure of specialization has set in, coupled with the retention of a number of archaic characters. These are all closely related to the genera *Leptoperla* of Newman (1839) and *Gripopteryx* of Pictet (1841). They therefore form the family Leptoperlidæ, this name replacing the name Gripopterygidæ used by Enderlein to include not only these insects, but also the Eustheniidæ and Austroperlidæ of this paper. Parenthetically, it may be remarked that Enderlein, in forming his family, entirely ignored

*An excellent figure of the wings of *Eusthenia spectabilis* Gray is to be seen in Comstock's "The Wings of Insects," (1918), p. 247, Fig. 246.

Newman's genus, and did not even give it a place in his dichotomic tables, though he must have known of its existence.

The characters that distinguish the Leptoperlidæ, as here defined, (Text. Fig. 4), are the loss of 1A in the forewing, leaving only two anal veins, 2A and 3A, of which the latter is always forked; the cubitus of the forewing either simple or once forked; the absence of archedictyon in the anal area of the hindwing; the presence of the re-entrant angle at the distal end of $Cu_2$; the presence in the hindwing of a fusion of $M_{3+4}$ with $Cu_1$ for part at least of their lengths; the possession, as in Eustheniidæ and Austroperlidæ, of the archaic type of tarsal joints, mandibles, clypeus and labrum, and the widely separated front coxæ. In the larvæ, there is a unique development of a rosette of gill-filaments around the anus; no other type of gill is present.

There remain over only a few very reduced forms of Nemouridæ, found equally in Australia, Tasmania, New Zealand and Southern Chile, of which the genus *Udamocercia* End. contains at present the only described species. These are true Nemourids in the widest sense, the imagines having the cerci reduced to one joint, while the same is true for the larvæ, which also have no visible gills.

Owing to a fortunate meeting with Mr. Nathan Banks, of the Museum of Comparative Zoology at Cambridge, Mass., I have recently been able to discuss my plan of classification for the Notogæan Perlaria with him, and to learn from him more details of the morphology of those genera not represented in our Southern fauna than was possible with the limited material at my command. I wish here to express to Mr. Banks my very grateful thanks for a very illuminating discussion which I had with him, in which he clearly set forth the main characters of the various genera of the Northern Hemisphere, and pointed out what he considered the basic errors of accepted classifications. As soon as I had succeeded in convincing him that the Eustheniidæ and Austroperlidæ, as defined in this paper, had no close relationship with the Pteronarcidæ proper, the rest became "plain sailing," and we soon arrived at a complete scheme of classification which illustrates the phylogeny of the Order well, and at the same time offers excellent characters for the systematist.

The first point to be noted is that the old line of evolution which began with the Eustheniidæ and Austroperlidæ, is carried on by the Nemouridæ and Capniidæ. Both these families retain the original form of mandibles, clypeus and frons, while they also keep the primitive widely separated front coxæ. As regards their wing venation, both can be developed by further specialization from types found within the Leptoperlidæ; but the Capniidæ have progressed a point further than the Nemouridæ, in having lost the fork of 3A in the forewing. On the other hand, the Capniidæ have retained the original many-jointed cerci; while, in the Nemouridæ, these processes are reduced, both in larva and imago, to a single joint. Mr. Banks and I quite agreed that the elevation of the groups of *Taeniopteryx*, *Nemoura* and *Leuctra* to full family rank was not justified; and, in this paper, these groups are considered to be only subfamilies of the Nemouridæ.

The second point to note is that the two families Pteronarcidæ and Perlidæ (this latter including the Perlodidæ, which are at most only a subfamily of the Perlidæ) form an evolutionary sideline marked by certain high specializations

coupled with a primitive venational scheme, viz., reduction of the mandibles to a weak lamina, (in the case of *Perlidæ* followed by an inturning of the clypeus and labrum under the frontal shelf, so that neither of these parts is visible from above), and, in the larva, either absence of gills or replacement of the original segmental gill-appendages of the abdomen by secondary gill-tufts around the bases of the legs and on the first two abdominal segments. Within this complex, the Pteronarcidæ keep the more primitive form of venation, very similar to that of the Austroperlidæ; like these latter, they have lost both the archedictyon of the anal fan and also the original complete contour of the outer margin of the hindwing. They are also specialized in a unique manner by the approximation of the fore coxæ. On the other hand, the Perlidæ have a somewhat more advanced venational scheme, though some of the original cross-venation still persists in the Perlodinæ; the fore coxæ remain widely separated, but the joints of the tarsi become specialized, both first and second joints being very short, and the third much longer than both these two together. The Perlodinæ differ only from the Perlinæ in the more complete cross-venation of the distal portion of the wing, and therefore cannot be granted at the most more than subfamily rank.

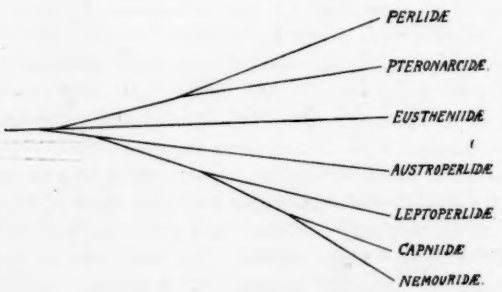


*Fig. 2.*—Phylogenetic diagram to show the relationships of the various families of the Order Perlaria. The Eustheniidæ are the remains of the original stock, without any specialized characters. The main line of evolution leads first to the Austroperlidæ, from them to the Leptoperlidæ, and culminates in the Capniidæ and Nemouridæ. From far back along the Eustheniid line, an evolutionary sidebranch gave origin to another distinct group, out of which arose the Pteronarcidæ and the Perlidæ.

The differences of the various families may be clearly set out in the following table, in which characters marked A are to be regarded as archaic, those marked B as specialized, while the addition of the letter U to either indicates that it is unique for the family. In the last line, the percentage of archaic characters present for the most archaic members of each family is calculated, the number so obtained giving a fairly reliable indication of the position of the family in the line of evolution. It should always be borne in mind that there are two culminating points for the family, viz., the Perlidæ on the one hand, as the end of a side-branch of evolutionary effort, and the Nemouridæ on the other, as the end of the main line of ascent of the Order. This idea is indicated in the Phylogenetic Diagram given in Text Fig. 2.

## TABLE SHOWING PRINCIPAL CHARACTERS FOR THE FAMILIES OF THE ORDER PERLARIA.

| Character | Family | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Eustheniidæ* | *Austroperlidæ* | *Pteronarcidæ* | *Perlidæ* | *Leptoperlidæ* | *Capniidæ* | *Nemouridæ* |
| (1) Mandibles:—A normal; B, reduced to lamina | A | A | B | B | A | A | A |
| (2) Clypeus and Labrum:—A, normal; B, hidden | A | A | A | BU | A | A | A |
| (3) Palpi:—A, with short joints; B, one or more joints elongated | A | A | A | B* | A | B* | B* |
| (4) Anterior coxæ:—A, wide apart; B, approximated. | A | A | BU | A | A | A | A |
| (5) Tarsal joints: — A, 2 least, 3 longer than 1; B, otherwise | A | A | A | B† | A | B† | B† |
| (6) Cerci:—A, with 5 or more joints; B, reduced to a single joint | A | A | A | A | A | A | BU |
| (7) Outer margin of hindwing:—A, complete convex whole; B, with reentrant angle at distal end of $Cu_2$ | AU | B | B | B | B | B | B |
| (8) Anal fan:—A, with cross-veins; B without | AU | B | B | B | B | B | B |
| (9) Cross-veins in distal half of forewing: — A, present; B, absent | A | A | A | A(B) | A | B | B |
| (10) Cubito-anal cross-veins in forewing: — A, present; B, absent | AU | B | B | B | B | B | B |
| (11) Branches of Rs in forewing:—A, 3 or more; B, 2 or 1 | A | A | A | A(B) | B | B | B |
| (12) Branches of $Cu_1$ in forewing:—A, 3 or more; B, 2 or 1 | A(B) | A(B) | A | A(B) | B | B | B |
| (13) Anastomosis or transverse cord:—A, absent; B, present | A | A | A | A(B) | A | B | B |
| (14) 1A in forewing: — A, present; B, absent | A | A | A(B) | B | B | B | B |
| (15) 3A in forewing: — A, forked; B, simple | A(B) | A | A | A(B) | A(B) | B | A |
| (16) Primitive paired lateral gills on abdomen: — A, present on segs. 1–5 or 1–6; B, absent | AU | B | B‡ | B‡ | B‡ | B | B‡ |
| Percentage of archaic characters§ for the most archaic members of each family | 100 | 75 | 63 | 44 | 56 | 25 | 25 |

*In Perlidæ not as elongated as in Capniidæ and Nemouridæ.

†In Perlidæ, 1 and 2 very short, 3 greatly elongated; in Capniidæ and Nemouridæ, either 1 or 2 elongated.

‡In Leptoperlidæ secondary gills are developed as an anal rosette; in some Pteronarcidæ, Perlidæ and Nemouridæ, secondary gill-tufts are developed in various positions on the thorax or base of abdomen.

§In the table, I have not included the character of the presence or absence of fusion of $M_{3+4}$ with $Cu_{1_1}$ or $Cu_{1_a}$, in hindwing, as I have been unable to study the tracheation of larval wings in all families. It should be noted that this fusion is absent in Eustheniidæ, but present in both Austroperlidæ and Leptoperlidæ.

KEY TO THE FAMILIES OF THE ORDER PERLARIA.

(1) Anal fan of hindwing well formed, and with a complete archedictyon or original meshwork of cross-veins; the contour of the outer margin of the hindwing a single convex whole, without any re-entrant angle at the end of $Cu_2$ ..... *Eustheniidæ*, n. fam. (Text Fig. 1).
Anal fan of the hindwing without any archedictyon; outer margin of hindwing with a marked re-entrant angle at end of $Cu_2$ ..... 2.

(2) Anterior coxæ closely approximated; cross-venation retained except on anal fan; mandibles reduced to a weak lamina ..... *Pteronarcidæ*.
Anterior coxæ remain widely separated ..... 3.

(3) Mandibles reduced to a weak lamina; clypeus and labrum become hidden beneath frontal shelf; last joint of tarsi much longer than 1 + 2 ..... *Perlidæ*.
Mandibles, clypeus and labrum remain normal; last joint of tarsi not longer than 1 + 2 ..... 4.

(4) In forewing, three anal veins are present, 1A running very close to $Cu_2$ ..... *Austroperlidæ*, n. fam. (Text Fig. 3).
In forewing, 1A is eliminated, leaving only 2A and 3A, the latter forked or simple ..... 5.

(5) In both wings, no true anastomosis connects the main veins from R to $Cu_1$ near middle of wing; cross-veins are always present in the distal portion of the wings ..... *Leptoperlidæ*, n. fam. (Text Fig. 4).
A true anastomosis or transverse cord is always present, connecting the main veins of both wings from R to $Cu_1$; cross-veins not usually present distad from the anastomosis ..... 6.

(6) (In forewing, 3A is forked; cerci are vestigial, being reduced to a single joint ..... *Nemouridæ*.
In forewing, 3A is simple; cerci remain long and many-jointed ..... *Capniidæ*

FAMILY AUSTROPERLIDÆ.

**Tasmanoperla**, n. g.

(Text Fig. 3).

Allied to *Austroperla* Needham, from which it differs only in the following points:—

Veins of the forewing very strongly marked, cross-venation very prominent, (*Austroperla* has the cross-venation weak, especially in the distal half of the wing, where the cross-veins are not easy to see in most specimens). In the forewing, 1A diverges from $Cu_2$ slightly, then converges towards it distally; (in *Austroperla* 1A lies very close to $Cu_2$ throughout, and is a much more weakly formed vein). Forewing considerably narrowed at the base, without any clearly marked anal angle; (in *Austroperla*, the forewing has a definite anal angle, distad from which the posterior margin runs almost parallel with the costal margin of the wing).

Genotype.—*Eusthenia diversipes*, n. sp. (Tasmania).

## Tasmanoperla diversipes, n. sp.

(Text Fig. 3).

No description of this species appears ever to have been published, although the name is mentioned in literature by Walker and others. It would seem probable that Westwood had made a MS description, from which the name was taken and used in print, without any corresponding description. The species is closely allied to *Eusthenia thalia* Newm., 1839, from which it may be distinguished as follows:—

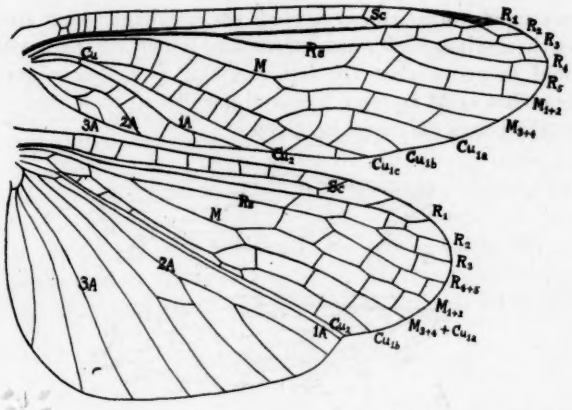


*Fig. 3.*—Venation of *Tasmanoperla diversipes* n. g. et. sp.; family Austroperlidæ.

Wing-veins brown, the costal veinlets of the forewing, and the distal ends of the main veins of both wings around the apices marked with small dark patches. Forewings very irregularly irrorated with brown, but a clear, unshaded patch of irregular shape is left at one-third from apex. (*E. thalia* Newm. has the forewing of a dark smoky colour, with a very clear and more regular, somewhat cream-coloured patch left unshaded in about the same position). Legs black, with rich brown marks at the bases of the femora and tibiæ; the brown on the hind femora occupies the basal half.

As in *E. thalia*, the wings are slightly shorter than the abdomen, the cerci rather short, the antennæ shorter than the forewing, and the prothorax absolutely square in shape.

Type.—Holotype female, in Coll. Tillyard.

Locality.—Mount Wellington, Tasmania, Jan. 31st, 1917.

This species is made the type of the genus *Tasmanoperla* as it is the one which I have studied and figured. I have, however, seen specimens of *E. thalia* Newm., and there can be no doubt that it also must be placed in this genus.

FAMILY LEPTOPERLIDÆ.

## Note on the Type Specimen of Leptoperla Beroe Newm.

(Text Fig. 4a).

The venational characters of *Leptoperla beroë* Newm., which is not only the type of the genus, but also the first Leptoperlid ever described, were not clearly given by Newman. The type is in the Hope Museum, Oxford. By the kindness of Professor Poulton, F. R. S., I was recently able to study this specimen carefully. Text Fig. 4 shows the venation of the right forewing, which has a peculiar aberrancy in that the two branches of M come together and fuse for a short space, and then separate again distally. The left forewing and both hindwings are much rolled and crumpled, the specimen being gummed on card. By softening these wings with warm water, and uncurling them with a fine brush, I was enabled to prove that the left forewing possesses a normal venation, with both branches of M running free and parallel to their tips. The following diagnosis for the genus may now be given:—

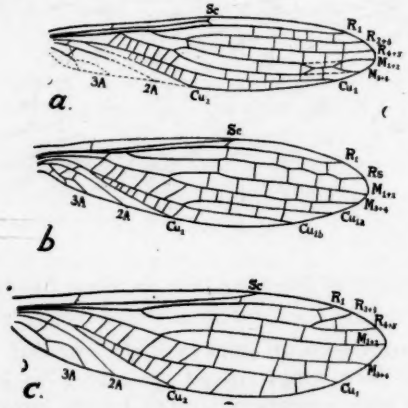


*Fig. 4.*—*A.* Right forewing of type specimen of *Leptoperla beroe* Newm. The normal courses of the branches of M, and the form of the crumpled anal area, as revealed by a study of the damaged left wing, are shown by dotted lines.
*B.* Right forewing of a specimen of *Dinotoperla opposita* (Walk.) from Mount Wellington, Hobart, Tasmania.
*C.* Right forewing of *Zelandobius confusus* (Hare) paratype, from Wellington, New Zealand.

*Antennæ* and *cerci* long, the latter considerably longer than the abdomen. *Forewing* with Sc stopping just short of half-way, its tip forked. Rs and M both forked not far from their origins, $Cu_1$ unforked and very long, running to the same level below the apex of the wing as that at which $R_1$ ends up above it. Complete sets of cross-veins between M and $Cu_1$ and also between $Cu_1$ and $Cu_2$. 2A simple, 3A forked. Irregular cross-veins enclosed in pale, oval spaces occupy positions in the distal half of the wing; (the wing membrane generally is of a brownish colour). *Hindwing* with Sc as in forewing; Rs simple; M with a free upper branch, and with its lower branch fused with $Cu_1$ to the border; $Cu_1$ simple; anal fan with five straight veins excluding 1A. (Cross-veins present

in hindwing are the humeral, an oblique one connecting $R_1$ with Rs towards half-way, and two connecting $Cu_2$ with the fused vein above it in its distal half).

The locality for this species is Tasmania. Though I have collected carefully in many places throughout the island, I have never met with it. The common Leptoperlids of Australia, Tasmania and New Zealand do not belong to this genus.

**Dinotoperla**, n. g.
(Text Fig. 4b).

Cerci shorter than the abdomen. Third joint of tarsus slightly longer than basal joint. Forewings with Rs simple, $Cu_1$ deeply forked, and complete sets of cross-veins between M and $Cu_1$, and also between $Cu_1$ and $Cu_2$. Hindwing with only slight fusion between $M_{3+4}$ and $Cu_1$, and with the anal fan narrower than the rest of the wing at the end of $Cu_2$.

Genotype.—*Leptoperla opposita* Walker, Tasmania.

This genus differs radically from *Leptoperla* Newm. in its much shorter cerci, its longer distal joint of the tarsi, in the loss of the fork of Rs and in the retention of the fork $Cu_1$. It is closely related to *Gripopteryx* End. and *Paragripopteryx* End., from South America (these two genera are barely distinct), but can be at once separated from them by the unforked Rs of the forewing and by the possession of the complete series of cross-veins between M and $Cu_1$.

A number of undescribed species of this genus occur in Australia and Tasmania.

**Zelandobius**, n. g.
(Text Fig. 4c).

Allied to *Gripopteryx* End. and *Paragripopteryx* End. from South America, but distinguished at once from them by possessing a simple $Cu_1$ in forewing and a wide anal fan in the hindwing, as well as by the retention of the complete series of cross-veins between M and $Cu_1$ in forewing. Rs is distally forked as in *Gripopteryx* and *Paragripopteryx*.

Genotype.—*Leptoperla confusa* Hare, New Zealand.

*Leptoperla hudsoni* Hare also goes into this genus, but *L. fulvescens* Hare and *L. maculata* Hare belong to *Aucklandobius* End. All these species are from New Zealand.

*Zelandobius* differs from *Aucklandobius* in having Rs distally forked in the forewing, and the fusion of $M_{3+4}$ with $Cu_1$ not complete in hindwing. *Aucklandobius* differs from *Antarctoperla* End. chiefly in its much wider anal fan and in the complete fusion of $M_{3+4}$ with $Cu_1$ in hindwing.

Both *Zelandobius* and *Aucklandobius* are represented in New Zealand by a number of undescribed species. The *Leptoperlidæ* of South America are evidently closely allied to those of New Zealand and Australia, and a knowledge of all the forms is necessary for the study of those in any one region.

EXPLANATION OF TEXT FIGURES.

1A, 2A, 3A, first, second and third anal veins, respectively; $Cu_1$, first cubitus, with its branches $Cu_{1a}$, $Cu_{1b}$, $Cu_{1c}$, $Cu_{1d}$; $Cu_2$, second cubitus; $M_{1+2}$, $M_{3+4}$, the two branches of the media; $R_1$, radius; Rs, radial sector, with its branches $R_2$, $R_3$, $R_4$, $R_5$; Sc, subcosta.

## A NEW SPECIES OF COPTODISCA. (LEPID.)

BY WM. G. DIETZ,
Hazleton, Pa.

**Coptodisca kalmiella,** n. sp.

Size minute. Head, palpi and antennæ silvery gray, the latter long. Fore-wings golden-brown from the base to about the middle of their length, passing gradually into golden yellow; a silvery, triangular band-like spot at about two-thirds the wing length, on both the costal and posterior margins, the apices of which nearly meet on the disk, and margined proximally and distally with black. Cilia nearly double the width of the wing, traversed by the bases of the black-margined silvery spots, a black costal stria before the apex; a trapezoidal black spot in basal two-thirds of the cilia, at the apex, surmounted by a black line extending to the edge of the cilia; basal two-thirds of dorsal cilia in apical third with two broad, concentric lines separated by a pale line of the ground colour; proximad to this is a brownish tuft, from base to free margin of cilia; rest of cilia, a brownish gray. Hind wings very narrow; cilia about three times their width. Legs and body, silvery gray.

*Habitat.*—Browns Mills, N. J., mining leaves of *Kalmia angustifolia.* Collectors, H. B. Weiss and C. S. Beckwith, June 22 to June 30. Type and paratypes in collection of H. B. Weiss.

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## NOTES ON COPTODISCA KALMIELLA DIETZ, A LEAF MINER OF KALMIA ANGUSTIFOLIA.

BY HARRY B. WEISS AND CHARLES S. BECKWITH,
New Brunswick, N. J.

This microlepidopteron first attracted our attention at Brown's Mills, N. J., by its work on the leaves of sheep laurel (*Kalmia angustifolia* L.) which were observed to be full of small oval holes. Closer observation revealed mines inhabited by lepidopterous larvæ and upon rearing them, we secured a species of *Coptodisca* which was kindly described by Dr. W. G. Dietz as *kalmiella.*

The mines of this species are irregular and blotch-like, extending from the midrib almost and sometimes entirely to the edge of the narrow leaf. They are visible on both sides of a leaf, more so on the upper where they appear as reddish brown, dry areas partly filled with excrement. The number of mines in a leaf varied from one to twelve. Twenty-nine leaves were found to average five mines to a leaf. In some leaves many of the mines ran together and took up most of the leaf surface. Leaves on all parts of the plants were infested, especially terminal ones.

During the last week of May many mines were found to contain full-grown larvæ, and many were empty. From this it appears as if the larvæ over-wintered in the mines and that our observations started just as the larvæ were leaving. When full grown the larva cuts an oval case (3 mm. long; 1.6 mm. wide) from a part of the mine which is free from excrement, this case consisting of the semi-transparent upper and lower leaf surfaces which are fastened together. This oval case is regular in outline with a clean cut edge. When the oval is completely cut, the case containing the larva either drops to the ground or the larva crawls to the tip of a leaf pulling the case after it, and finally drops

to the ground after hanging a short time suspended by a thread. Once on the ground the larva crawls under fallen leaves, etc., and pupates within the case, this stage requiring from two to three weeks, the moths appearing about June 20 and being plentiful a week later around sheep laurel in the field. In order to facilitate the emergence of the moth, the pupal case projects slightly from the oval case. It is not known how many broods occur in New Jersey. Probably the over-wintering larvæ are those which hatch from eggs deposited during July.

*Kalmia angustifolia* L., is frequent in sandy ground, especially around the edges of bogs in the pine barrens and often covers large areas. In view of this, the miner should be found in many other localities in the pine barrens. Dr. Dietz writes that he has bred this species in numbers from sheep laurel collected in Pennsylvania and has noted as many as twelve to fourteen mines in a single leaf.

*Full-grown Larva.*—Length 3.4 mm. Width 0.5 mm. Head and first two segments brownish, remainder of body white with greenish tinge, somewhat translucent; elongate, tapering slightly posteriorly; body notched at sides, flattened dorso-ventrally; head small, mouth-parts dark, first thoracic segment longest, second and third thoracic segments subequal in length; abdominal segments subequal in length except in the ultimate and penultimate which combined approximate the length of the preceding segment; first thoracic segment not quite as wide as the second and third which are subequal in width; abdominal segments subequal in width except the last three or four which are narrower; prothorax bears a dorsal, dark spot which covers most of the surface; dorsum of meso- and metathorax bears a somewhat similar dark area each with separated, subcircular light areas. First seven abdominal segments bear irregular, oval, ill-defined dark areas; dorsal markings of eighth abdominal segment somewhat similar to those on dorsal surface of metathorax, the subcircular light areas may be fused or only slightly separated; dorsal surfaces of remaining abdominal segments may bear indications of dark areas or be entirely light; ventral surface and markings similar to those of dorsal surface except that the dark areas on the third, fourth, fifth and sixth abdominal segments are replaced by dark, oval rings; head and sides of each thoracic segment bear several fine hairs; a single hair on side of each abdominal segment; dark areas appear to be finely shagreened; shagreening on prothorax more pronounced.

Another lepidopterous miner of sheep laurel was described by Dr. Dietz in 1907 (Tr. Am. Ent. Soc. XXXIII, p. 291). This is *Ornix kalmiella*, the larva of which makes a pale, orange coloured, blotch-like mine in the upper side of a leaf. The localities for this species as given by Dr. Dietz are Pa. and Conn., larvæ, August and September; adults, following May.

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## CHANGE OF ADDRESS.

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# PSEUDOMACROMIA NATALENSIS AND MERUENSIS (ODONATA).

BY S. G. RICH,
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The present paper arises from the peculiarities of a specimen of *Pseudomacromia* collected by me at Edendale, Natal, on Nov. 12, 1918, and now in my collection. The specimen is a female, measuring abdomen including appendages 40 mm., hind wing 43 mm., fore wing 43 mm., both pterostigmas 3 mm.

The specimen has the following features of interest. Lower lip yellow brown on side lobes, with centre lobe black and a black rim on the mesal edge of each side lobe. Upper lip bordered with very dark brown. Across frons immediately above lip, a dull greenish band about 1 mm. wide. Top of frons steel blue. Vertex brown, with traces of steel blue. Both wings flavescent from beneath stigma mesally, the fore wing until one cell from nodus, the hind wing half way to nodus; this is a vague cloudy flavescence except at the costal border of the fore wing. There is a very faint flavescence extending to the first cross-vein under the subcosta and the cubitus of the fore wing, and a stronger flavescence in the same place and four cells closest to the membranule in the hind wings. The abdomen has the first two segments yellow-brown with a thin, black band, marking the end of segment 2; segment 3 has a thin-lined yellowish cross on the back, on an otherwise dark ground; the other segments are dark brown with narrow, dull yellow markings along the sides. The membranule of the wings is grayish, becoming cream-coloured at its costal end.

Barring the head details and the basal flavescence of the fore wing, the specimen agrees with Martin's original description of *P. natalensis* female (Bull. du Museum d'Histoire Naturelle, 1900, p. 106).

In the Selys Catalogue, Fasc. XIV, p. 805, there is given in brackets the species *P. meruensis*, from Kilmandjaro, East Africa. This, described as *Homothemis meruensis* by Sjostedt, 1909, was not in the Selys collection, but Dr. Ris quotes the original description and assigns it to the genus *Pseudomacromia*. The present specimen agrees equally with this description, more especially as to the lips, frons, colouring of legs, and wing-flavescence. The dimensions are as in this description.

In view of the fact that the description of *P. meruensis* is based upon a single specimen, and that no others of this species are recorded in the Selys catalogue, I am strongly of the opinion that the two species are identical. *P. natalensis* is recorded from as far north as Macequece, Portuguese East Africa, in the Selys catalogue, and it is not unreasonable to expect that it would be found in the highlands of East Africa nearer the equator.

Martin's original description of *P. natalensis* is, except for the lips, and the cross-mark upon the back of the abdomen, identical with Sjostedt's of *P. meruensis*. The synonymy of these two species may be taken as highly probable, if not established.

It may be of additional value in this connection to mention the characteristics of a specimen of *P. natalensis*, in the collection of the Durban Museum, Natal. The specimen is a female, taken at Umbilo, one of the suburbs of Durban. It agrees with my specimen in possessing all the features which would show the identity of *P. natalensis* and *P. meruensis*. The flavescence

on the wing is somewhat fainter than in mine, but in the fore wing extends from the stigma to the nodus, and in the hind wing covers some seven cells close to the stigma only. The basal flavescence is as in mine. The dull green band across the frons is more prominent.

The two specimens have femora that answer to the description of either species: the first and second femora light brown, the third darker, but light brown at the base.

In both specimens the claws are not alike throughout. In each case approximately half of the claws have the lateral spur of the same length and breadth as the tip of the claw proper, and the remainder have the spur slightly thicker. *P. meruensis* is described as having the spur similar to the tip; *P. natalensis* (in the Selys catalogue) as having the spurs thicker.

The pterostigmas of the museum specimen are all 2.3 mm. long; in mine they are .5 mm. longer.

There is every evidence that the two are of the same species; yet the museum specimen is clearly *P. natalensis* and mine may be *P. meruensis* equally as well, according to description. The identity of the two species, as stated above, appears highly probable, if not fully proven.

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## A NEW RACE OF *STRYMON MELINUS* HBN.

BY J. MCDUNNOUGH, PH.D.*
Entomological Branch, Ottawa.

**Strymon melinus atrofasciata,** var. nov.

♀.—Upper side rather deep slaty-gray with maculation similar to that of the Eastern race (*humuli* Harr.). Beneath even slaty-gray with no tinge of brown, the post-median row of spots heavy, black, especially prominent on secondaries; these spots are bordered outwardly with white but show practically no traces of orange colour on their inner margin. The subterminal maculation is the same as in the type form with the orange spots very bright in colour.

♂. Similar to ♀, but slightly darker on upper side with ground colour on both sides showing a faint brownish ringe.

*Holotype.*—1 ♀, Wellington, B. C., (July 12th, 1904), (G. W. Taylor), in Canadian National Collection.

*Allotype.*—1 ♂, Duncan, B. C., (C. Livingston), in same collection.

*Paratypes.*—2 ♀'s, Royal Oak, B. C., (May 26th, 1917), (R. C. Treherne); Victoria, B. C., (May 21st, 1917), (A. E. Cameron), in Canadian National Collection.

The above race, characterized by its dark ground colour and heavy black spotting on under side with lack of orange margin to spots, seems confined to Vancouver Island. It bears apparently a certain relation to *pudica* Hy. Edw. in this lack of orange, but this latter race is described as having the lower side "more silvery grey" than *melinus* with obsolescent maculations whereas the heavy black maculation of the underside in the present race is a feature that at once strikes the eye.

*Contribution from the Entomological Br., Dept. of Agr., Ottawa.

# THE LARVA AND BREEDING PLACE OF *AEDES ALDRICHI* DYAR AND KNAB. (CULICIDÆ, DIPTERA).

BY ERIC HEARLE,
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*Aedes aldrichi* is the dominant mosquito in the Lower Fraser Valley, B. C., and the main cause of the serious mosquito pest that at times occurs in that district and casts an evil shadow over the most beautiful period of the year. Previous to the summer of 1920, the larva had been unknown and there were no definite data as to its breeding place. Extensive larval collections have shown the main breeding places to be in the wooded river bottoms. These areas are thickly covered with cottonwood and a tangled low growth of willow, rose and spiræa. They are locally known as alder-bottoms. At freshet time flooding converts them into temporary swamps capable of producing enormous numbers of mosquitoes. *Aedes vexans* and *Aedes cinereus* occur with *Aedes aldrichi* in these alder-bottom areas, but the latter is the chief species.

## Description of Larva of Aedes aldrichi.

*Stage IV.*—A stout dark grey larva, very much like that of *Aedes hirsuteron* and *Aedes aestivalis*, from which it differs mainly in the dorsal head hairs and, in the case of *hirsuteron*, in the laterals of the sixth abdominal segment.*

Head with a dark patch on the vertex; broad, narrowed before the eyes; front roundly arcuate. Antennæ, inserted at notch in head, yellowish, moderate, curved, swollen at base, fairly thickly covered with large and small spines; antennal tuft of about seven hairs of moderate length placed a little before centre; at the apex are four short spines, one long spine and one short bud-like process. Eyes transverse and pointed. Upper pair of dorsal head hairs usually in twos and lower head hairs single; ante-antennal tuft of about seven hairs. Mental plate broadly triangular with a small, central tooth and fourteen to seventeen teeth on each side, those toward base largest. Thorax rounded, wider than long, hairs abundant and fairly long. Abdomen stout, anterior segments shorter and broader, hairs sparse, laterals moderately long, secondaries short; laterals usually double from second to sixth segment, but often in threes on third segment; first segment with two pairs of fairly long hairs. Air tube stout, about three times as long as wide; pecten of about seventeen evenly spaced teeth reaching to middle; teeth gradually larger distally; individual tooth a long spine with broad base, a stout spine at base and a very small tooth between this and the main spine; a tuft of six hairs following the pecten. Lateral comb of eighth segment of about twenty-five scales in a broad triangular patch; scales three deep; individual scales broadly elliptical, fringed with short delicate spines from centre outwardly, a longish stout spine at apex. Dorsal plate reaching nearly to ventral line. Dorsal tuft a brush of about eight hairs and one long hair on each side. Ventral brush well developed. Anal gills ensiform and about twice as long as eighth segment. Skin of larva covered with minute spicules.

*Note.—A great deal of variation occurs and a good series is needed to ensure accurate determinations. The dorsal head hairs are not very constant. In many cases the upper dorsal head hairs are in threes and the lower head hairs in twos, sometimes they occur in fours and in threes, but in only a very few specimens examined were the upper head hairs found to be single as in *aestivalis*. In many specimens some of the abdominal laterals were found to be in threes, but the sixth laterals are always paired, unlike those of *hirsuteron*, in which they are single.

Mailed February 28th, 1921